Smart Irrigation System using Controllers
Gokulrajess, P1, Revanth, S2, Soundar Rajan2, Logesh4
UG Student1, 2, 3, 4
Department of Electronics and Communication
SRM Institute of science and Technology, Ramapuram, Chennai, India

Abstract:
Agriculture is referred as the back bone of our country, but due to several problems the overall productivity of farmlands has been dropped. The major problem for agriculture is inadequate amount of rainfall. Due to these farmers have opted for artificial supply of water to crops. In this project we have created an automatic irrigation mechanism which turns the pumping motor ON/OFF based on the dampness (moisture content) of the soil. The use of automated irrigation mechanism may reduce the manual effort of farmers to turn the motor ON/OFF. The soil dampness is measured using a sensor which works on the principle of change in conductivity. The conductivity change is based on the water content between the probes of the sensor being inserted in the soil. Wet soil will be more conductive than Dry soil. Whenever there is less dampness in soil the controller automatically turns the motor ON/OFF manually. Here a sensor is inserted in the soil, which measures the soil dampness (moisture content) based on the output signal is more, this signal is compared with the predefined value and if the measured value exceeds the predefined value the motor is turned ON, simultaneously the farmer is informed about this through GSM. Similarly, the intrusion of wild animals would also be indicated through GSM.

Keywords: Conductivity, Dampness, GSM-Global system for mobile, PIC Controller-programmable interface controller, PIR-Passive infrared sensor.

1. INTRODUCTION
In recent years there is a continuous increase in demand for food. Agriculture is the only source for food production. But there are several problems which decreases the productivity. Some major problems are inadequate amount of rainfall due to monsoon failure, intrusion of wild animals which would destroy the farm yields and theft of important farming equipment kept in motor room. In this project we have used some mechanisms to overcome these problems. To ensure regular supply of water to the crops here we use automatic irrigation mechanism for farmlands utilizing drip irrigation techniques, where the farmer need not have to turn the motor ON/OFF manually. Here a sensor is inserted in the soil, which measures the soil dampness (moisture content) based on the water content. More the water content in the soil between the probes of the sensor lesser is the resistivity and hence the output signal is more, this signal is compared with the predefined value and if the measured value exceeds the predefined value the motor is turned ON, simultaneously the farmer is informed about this through GSM. Similarly, the intrusion of wild animals would also be indicated through GSM.

1.2 CONCEPT OF MODERN IRRIGATION SYSTEM
Irrigation is the method in which a controlled amount of water is supplied to plants at regular intervals for agriculture. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and revegetation of disturbed soils in dry areas and during periods of inadequate rainfall. Additionally, irrigation also has a few other uses in crop production, which include protecting plants against frost, suppressing weed growth in grain fields and preventing soil consolidation. In contrast, agriculture that relies only on direct rainfall is referred to as rain-fed or dry land farming. Irrigation systems are also used for dust suppression, disposal of sewage, and in mining. Irrigation is often studied together with drainage, which is the natural or artificial removal of surface and sub-surface water from a given area.

1.3 TYPES OF IRRIGATION
Various types of irrigation techniques differ in how the water obtained from the source is distributed within the field. In general, the goal is to supply the entire field uniformly with water, so that each plant has the amount of water it needs, neither too much nor too little.

1.3.1 SURFACE IRRIGATION
In this system, water moves across the surface of agricultural lands, in order to wet it and infiltrate into the soil. Surface irrigation can be subdivided into furrow, border strip or basin irrigation. It is often called flood irrigation when the irrigation results in flooding or near flooding of the cultivated land. Historically, this has been the most common method of irrigating agricultural land and still used in most parts of the world. Where water levels from the irrigation source permit, the levels are controlled by dikes, usually plugged by soil. This is often seen in terraced rice fields (rice paddies), where the method is used to flood or control the level of water in each distinct field. In some cases, the water is pumped, or lifted by human or animal power to the level of the land. The field water efficiency of surface irrigation is typically lower than other forms of irrigation but has the potential for efficiencies in the range of 70% - 90% under appropriate management.

1.3.2 IRRIGATION USING SPRINKLER SYSTEM
Here water is piped to one or more central locations within the field and distributed by overhead high-pressure sprinklers or guns. A system utilizing sprinklers, sprays, or guns mounted overhead on permanently installed risers is often referred to as a solid-set irrigation system. Higher pressure sprinklers that rotate are called rotors and are driven by a ball drive, gear drive, or impact mechanism. Rotors can be designed to rotate

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in a full or partial circle. Guns are similar to rotors, except that they generally operate at very high pressures of 40 to 130 lbf/in² (275 to 900 kPa) and flows of 50 to 1200 US gal/min (3 to 76 L/s), usually with nozzle diameters in the range of 0.5 to 1.9 inches (10 to 50 mm). Guns are used not only for irrigation, but also for industrial applications such as dust suppression and logging.

Sprinklers can also be mounted on moving platforms connected to the water source by a hose. Automatically moving wheeled systems known as traveling sprinklers may irrigate areas such as small farms, sports fields, parks, pastures, and cemeteries unattended. Most of these utilize a length of polyethylene tubing wound on a steel drum. As the tubing is wound on the drum powered by the irrigation water or a small gas engine, the sprinkler is pulled across the field. When the sprinkler arrives back at the reel the system shuts off. This type of system is known to most people as a "water reel" traveling irrigation sprinkler and they are used extensively for dust suppression, irrigation, and land application of waste water.

1.3.3 DRIP IRRIGATION

Drip (or micro) irrigation, also known as trickle irrigation, functions as its name suggests. In this system waterfalls drop by drop just at the position of roots. Water is delivered at or near the root zone of plants, drop by drop. This method can be the most water-efficient method of irrigation, if managed properly, since evaporation and runoff are minimized. The field water efficiency of drip irrigation is typically in the range of 80 to 90 percent when managed correctly. In modern agriculture, drip irrigation is often combined with plastic mulch, further reducing evaporation, and is also the means of delivery of fertilizer. The process is known as fertigation. Deep percolation, where water moves below the root zone, can occur if a drip system is operated for too long or if the delivery rate is too high. Drip irrigation methods range from very high-tech and computerized to low-tech and labor intensive. Lower water pressures are usually needed than for most other types of systems, with the exception of low energy center pivot systems and surface irrigation systems, and the system can be designed for uniformity throughout a field or for precise water delivery to individual plants in a landscape containing a mix of plant species. Although it is difficult to regulate pressure on steep slopes, pressure compensating emitters are available, so the field does not have to be level. High-tech solutions involve precisely calibrated emitters located along lines of tubing that extend from a computerized set of valves.

2. LITERATURE SURVEY

Automatic irrigation system on sensing soil moisture content
M.Nagarajapandian, U.Ram Prasanth, G.Selva Kumar, S.Tamil Selva-2015. This project on “Automatic Irrigation System on Sensing Soil Moisture Content” is intended to create an automated irrigation mechanism which turns the pumping motor ON and OFF on detecting the dampness content of the earth. In the domain of farming, utilization of appropriate means of irrigation is significant. The benefit of employing these techniques is to decrease human interference and still make certain appropriate irrigation. This automated irrigation project brings into play an Arduino board ATmega328 micro-controller is programmed to collect the input signal of changeable dampness circumstances of the earth via dampness detecting system.

GSM Based automatic Irrigation Control System for Efficient Use of Resources and Crop Planning by using an Android Mobile-D.S. Pavithra, M. Srinath-2014. Mobile phones have almost become an integral part of human life serving multiple needs of humans. This application makes use of the GSM/GPRS [General Packet Radio Service] feature of mobile phone as a solution for irrigation control system. GSM (Global System for Mobile Communication) is used to inform the user about the exact field condition. The information is passed onto the user request in the form of SMS.

Automated Irrigation System Using a Wireless Sensor Network and GPRS Module-Joaquin Gutierrez, Juan Francisco VillaMedina, Alejandra NietoGaribay, and Miguel Angel Porta-Gandara-2013. An automated irrigation system was developed to optimize water use for agricultural crops. The system has a distributed wireless network of soil-moisture and temperature sensors placed in the root zone of the plants. This irrigation system allows cultivation in places with water scarcity thereby improving sustainability. The use of GSM/GPRS module facilitates communication between the controller and mobile phone by sending alert messages.

Microcontroller Based Automation of Drip Irrigation System
S. Mahendra, M. Lakshmana Bharathy-2013. The green house based modern agriculture industries are the recent requirement in every part of agriculture in India. In this technology, the humidity and temperature of plants are monitored. Due to the variable atmospheric circumstances these conditions sometimes may vary from place to place in large farmhouse, which makes very difficult to maintain the uniformity at all the places in the farmhouse manually. Therefore, there is an intense need to develop such Microcontroller based embedded system, which could maintain the physical parameters uniform.

3. EXISTING SYSTEM

In conventional farming method, one has to put his manual effort for irrigation. The farmer has to turn the motor ON/OFF manually. This method may require human effort and wastage of water if more amount of water is supplied than required amount, which would even lead to spoilage of crops. Moreover some traditional techniques of soil moisture measure have been carried out which tends to be time consuming.
3.1 ACOUSTIC METHOD
In this method acoustic pulses are transmitted through the soil and they are received and then investigated.

![Figure 3.1 Acoustic method](image1.jpg)

3.2 GRAVIMETRIC METHOD
In this method, the soil moisture content may be expressed by weight as the ratio of the mass of water present to the dry weight of the soil sample, or by volume as the ratio of volume of water to the total volume of the soil sample.

![Figure 3.2 Gravimetric method](image2.jpg)

3.3 DIELECTRIC METHOD
Dielectric soil moisture sensors determine soil moisture content by measuring an electrical characteristic of soil. The dielectric constant is about 1 for air, 3 to 5 for soil particles, and about 80 for water. The relatively large constant of water means that the dielectric constant of bulk soil is higher when the soil contains more moisture.

![Figure 3.3 Dielectric method](image3.jpg)

4. SYSTEM COMPONENTS

4.1 PIC MICROCONTROLLER
The PIC microcontroller PIC16F877a is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it uses FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output. PIC16F877A also have many applications in digital electronics circuits. An EEPROM is also featured in it which makes it possible to store some of the information permanently like transmitter codes and receiver frequencies and some other related data. The cost of this controller is low and its handling is also easy. It’s flexible and can be used in areas where microcontrollers have never been used before as in coprocessor applications and timer functions etc.

![Figure 4.1 Pic microcontroller](image4.jpg)

4.2 SENSORS

4.2.1 SOIL MOISTURE SENSOR
Soil water content is an expression of the mass or volume of water in the soil, while the soil water potential is an expression of the soil water energy status. The relation between content and potential is not universal and depends on the characteristics of the local soil, such as soil density and soil texture. The basic technique for measuring soil water content is the gravimetric method. Because this method is based on direct measurements, it is the standard with which all other methods are compared. Unfortunately, gravimetric sampling is destructive, rendering repeat measurements on the same soil sample impossible. Because of the difficulties of accurately measuring dry soil and water volumes, volumetric water contents are not usually determined directly.

![Figure 4.2 Soil moisture sensor](image5.jpg)

A probe type sensor is used. This sensor measures the volumetric water content. The soil moisture sensor is inserted in the soil. Depending on the quality of the sensor, it must be inserted near the roots of the plant. The soil moisture sensor measures the conductivity of the soil. Wet soil will be more conductive than dry soil. The soil moisture sensor module has a comparator in it. The voltage from the prongs and the predefined voltage are compared and the output of the comparator is high only when the soil condition is dry.

4.2.2 TEMPERATURE SENSOR
The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the temperature.
Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1/4°C at room temperature and ±3/4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level.

4.2.3 PASSIVE INFRARED SENSOR

A passive infrared sensor is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. They are always used to detect whether a human has moved in or out of the sensors range.

4.3 GSM MODEM

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate. Designed for global market, SIM800 is a quad-band GSM/GPRS module that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM800 features GPRS multi-slot class 12/ class 10 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. With a tiny configuration of 24*24*3mm, SIM800 can meet almost all the space requirements in users' applications, such as M2M, smart phone, PDA and other mobile devices. SIM800 has 68 SMT pads, and provides all hardware interfaces between the module and customers' boards.

Computers use AT commands to control modems. Both GSM modems and dial-up modems support a common set of standard AT commands. GSM modem can be used just like a dial-up modem. In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards.

5. PROPOSED SYSTEM

In the proposed system the amount of moisture present in the soil can be measured with a simple sensor consisting of two probes which is inserted in the soil. Based on the water content between the sensor’s probes there will be some signal in the output pin. Based on the variation in the sensor value the motor will be turned ON/Off automatically. A temperature sensor is used to measure the environmental temperature. The status of the field would be indicated to the farmer through messages using a GSM. The intrusion of any animal or person can also be indicated using the GSM.

The sensors used have their own set of operations and according to each sensor the output is obtained and it is efficient when compared to the conventional methods and provides real time output.

6. SEQUENCE OF OPERATION

• The project consists of 3 sensors: Temperature sensor, PIR sensor, Moisture sensor.

• The PIR sensor detects the motion, whereas Moisture sensor senses the soil moisture content level, and the Temperature sensor detects the temperature level.

• The temperature and moisture level is indicated in the LCD board.

• When the moisture level is low i.e. output of moisture sensor is higher and an alert message reading the present moisture and temperature value will be sent to the farmers via GSM and the motor is ON.

• After sending the messages the controller again reads the analog values of the sensor and performs the corresponding action.

7. OUTPUT AND DISCUSSION

When PIR sensor value is high, an alert message reading “INTRUDER FOUND” will be sent via GSM. Under normal
conditions the current moisture and temperature values will be displayed under a string “AGRICULTURE”. Whenever there the soil moisture level and temperature level changes the LCD values are updated. When any motion is detected LCD displays “MOTION DETECTED” and the output is obtained.

8. CONCLUSION

Now a days, in this world where everything is being automated, here we bring an idea that could help not only the farmers but also the gardeners by the means of automatic irrigation system. Over irrigation due to poor distribution uniformity and under irrigation that leads to increased soil salinity can be avoided. The manual as well as automatic control of the motor helps the farmer by reducing their extensive travel efficiently.

9. REFERENCES


